Vakuumtechnik
Geräte Bauelemente

Vakuum-
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Meß- und
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LEYBOLD - HERAEUS

LEYBOLD-HERAEUS GMB.

GA 5.104
Gebrauchsanweisung
Operating Instructions
Mode d'emploi

TURBOVAC
150 CSV, 360 CSV

MP MASTER
MA32939

855 02 /03/04, 07 /08/09

SUPPLIED BY

PLASMA TECHNOLOGY

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1 Description

1.1 General

The TURBOVAC 150 CSV amd TURBOVAC 360 CSV turbomolecular pumps are oil-lubricated pumps that have been used for heavy-duty operation in semiconductors production.

They are installed vertically with at most 15° deviation from the perpendicular.

CSV stands for:
chemicals (suitable for corrosive media),
semiconductors (suitable for severe operating conditions),
vertical.

Please unpack the pump immediately after delivery, even if it is to be put into operation at a later date. Check that the delivery is complete (see Section 1.2) and carefully examine it visually.

If any damage is discovered, report it immediately to the forwarding agent and insurer. If the damaged part has to be replaced, please get in touch with Leybold-Heraeus's orders department.

In the text below, the references to diagrams, e.g. (1/4), consist of the Fig. No. and the Item No. in that order.

1.2 Standard Specification

The turbomolecular pump is delivered in a sealed polyethylene bag.
A flask (40 cm³) with special oil is supplied with the pump.

The solid-state frequency converter needed for running the pump has to be ordered separately.

High-vacuum intake port
TURBOVAC with ISO-K flange:
wire-mesh splinter guard,
centering ring with Viton O-ring, outer ring and half of the clamps required for connection.

TURBOVAC with CF flange:
wire-mesh splinter guard.

Forevacuum outlet port
Centering ring with Perbunan O-ring and clamping ring.

The purging-gas port is blanked off.

1.3 Technical Data

Pumping speed for N_2	
TURBOVAC 150 CSV	145 ltr/sec
TURBOVAC 360 CSV	345 ltr/sec
Recommended backing pump	
TURBOVAC 150 CSV	D 4 B (16 B)*
TURBOVAC 360 CSV	D 16 B (25 B)*
Ultimate pressure	$< 10^{-10}$ mbar
Forevacuum pressure	10^{-3} to 10^{-2} mbar
Rotational speed	
TURBOVAC 150 CSV	50,000 rpm
TURBOVAC 360 CSV	45,000 rpm
Runup time	
TURBOVAC 150 CSV	1.5 min
TURBOVAC 360 CSV	3 min
Cooling-water consumption, min.	approx. 20 ltr/h
Cooling-water connection, dia.	11 mm
Cooling-water temperature	10 to 25 °C
Oil charge, approx.	40 cm³

High-vacuum intake port	
TURBOVAC 150 CSV	DN 63 ISO-K or CF, DN 100 ISO-K
TURBOVAC 360 CSV	DN 100 ISO-K or CF, DN 150 CF
Forevacuum outlet port; 150/360	DN 25 KF
Bakeout temperature at pump neck	max. 100 °C
Mounting position	vertical, max. 15° deviation
Weight; 150/360	approx. 7/11 kg

* for purging gas operation

	Ref.No.
TURBOVAC 150 CSV, water-cooled	
with DN 100 ISO-K flange	855 02
with DN 100 CF flange	855 03
with DN 63 ISO-K flange	855 04
TURBOVAC 360 CSV, water-cooled	
with DN 100 ISO-K flange	855 07
with DN 100 CF flange	855 08
with DN 150 CF flange	855 09
TURBOTRONIK NT 150/360 solid-state frequency converter	854 72
Accessories	
Water flow monitor	853 26
Bakeout jacket 230 V	
TURBOVAC 150 CSV	854 33
TURBOVAC 360 CSV	854 53
Bakeout jacket 115 V	
TURBOVAC 150 CSV	854 34
TURBOVAC 360 CSV	854 54
Purging gas valve	
110 V/60 Hz	855 18
220 V/50 Hz	855 19
Forevacuum flange DN 40 KF	855 12
Refrigerator	853 39
Air-cooling option 220 V	855 06

Air-cooling option 115 V	894 06
Antivibration bellows DN 100 ISO-K	853 43
Antivibration bellows DN 100 CF	885 95

1.4 TURBOVAC

The design principle is identical for all TURBOVAC turbomolecular pumps. They consist of the multi-stage rotor assembly, stator and drive assembly. The upper rotor stages of the vertical axial-flow compressor are located in the immediate vicinity of the high-vacuum intake flange. The unavoidable impedance of the intake section is thus reduced to a minimum, hence ensuring the highest possible pumping speed. The blades have a particularly high circumferential speed, which makes for a high pumping speed and compression ratio. The material used for the rotor is a high-grade aluminium alloy subjected to a special hardening process. The graded configuration of the blades reduces tensile stresses on the blade roots to an uncritical amount and guarantees maximum operational safety of the rotor. If necessary, the stator (1/4) can be easily disassembled without having to remove the rotor (1/6) from the bearing shaft. Thus, the high-precision dynamic balancing of the rotor is maintained when the rotor and stator have to be cleaned. The complete drive assembly (1/8) with bearings is located in the forevacuum space.

The shaft is supported by two precision ball bearings lubricated with a special oil. The motor housing is cooled to protect the bearings against overheating.

The pump is cooled by either water or air. To prevent overheating, the frequency converter is switched off by an integrated thermal overload switch; the pilot lamp "STÖRUNG" (failure) then lights up.

A wire-mesh splinter guard (1/3) in the intake flange protects the pump against mechanical damage by foreign particles. The TURBOVAC is powered and automatically monitored by the TURBOTRONIK frequency converter, which controls the runup phase and protects the TURBOVAC against overloading in all operating statuses.

The TURBOVAC operates in the region of molecular flow where the geometrical dimensions of the blades are smaller than the mean free path of the molecules. Molecules entering the intake stages receive impetus in the direction of flow by the rapidly rotating blades. It is therefore necessary that the circumferential speed of the rotor blades is increased to the order of the mean molecular velocity.

An appropriate configuration of the rotor and stator blades insures that the transmission probability of molecules from the high-vacuum side toward the forevacuum side is considerably greater than in the opposite direction.

1.5 TURBOTRONIK

The TURBOTRONIK solid-state frequency converter is needed to power the medium-frequency motor in the TURBOVAC. The mains frequency of 50/60 Hz is converted to the specific operating frequency of the TURBOVAC motor. In order to obtain the shortest possible runup time, the motor is accelerated by means of the maximum available current and with nearly constant slip. By limiting the output current during runup and during operation under overload, the motor is protected against overloading, i.e. when the current limit is reached, the voltage is readjusted to a value which is proportional to the rotational speed of the motor. The pilot lamps at the front of the power supply unit show the respective operating status of the motor and pump.

The thermal overload switch in the THERMOVAC protects the motor against overheating during operation under overload. When the switch is triggered, the power supply unit is turned off and the pilot lamp "STÖRUNG" (failure) (2/4) lights up. If the motor is subjected to such a high load that the rotational speed and hence the frequency drop below approx. 150 Hz, the power supply unit is likewise switched off and a failure signalled by the pilot lamp. This lamp also signals an extraordinary operating status in the vacuum system, e.g a leak or an exceptionally large amount of gas.

The linecord for the TURBOTRONIK and the lead for connecting it to the TURBOVAC are supplied with the TURBOTRONIK.

1.6 Description of Accessories

1.6.1 Bakeout Jacket

The bakeout jacket allows automatically controlled bakeout of the TURBOVAC.

It is easily fitted directly below the intake flange of the TURBOVAC, even when the pump is flanged to the vacuum system.

For Ref.No., see Section 1.3.

1.6.2 Venting Port

On the side of the pump casing is a venting port (DN 10 KF) with nozzle and sintered-metal filter. The TURBOVAC can be vented "clean" via this flange (also see Fig. 4: Pressure rise time).

1.6.3 Purging Gas Valve

A purging gas valve is indispensable when pumping reactive or abrasive media. Normally there is no likelihood of damage to the rotor, stator plates and pump body, but if reactive or abrasive media come into contact with the ball bearings, the latter's service life may be considerably shortened.

Mount the purging gas valve at the flange (1/14) on the side of the pump's base flange.

For more details, see Operating Instructions GA 232/2.

For Ref.No., see Section 1.3.

1.6.4 Refrigerator

Normal tap water is generally sufficient for water-cooled turbomolecular pumps. Where such water is unavailable, has a high calcium content or is contaminated, it is advisable to use a refrigerator. Filled with clean water, it permits reliable operation of the TURBOVAC, even in mobile systems.

For more details, see Operating Instructions GA 243.

For Ref.No., see Section 1.3.

1.6.5 Air-Cooling Option

This option permits a water-cooled TURBOVAC to be converted to air cooling. No further changes are necessary.

Insure an adequate supply of fresh air.

For Ref.No., see Section 1.3.

1.6.6 Antivibration Bellows

The TURBOVAC is high-precision dynamically balanced (total vibration velocity < 0.1 mm/sec).

It is normally used without antivibration bellows. For connection of the TURBOVAC to instruments highly sensitive to vibration, e.g. electron microscopes or micro-balances, special antivibration bellows can be fitted to the high-vacuum intake flange.

For Ref.No., see Section 1.3.

1.6.7 Forevacuum Outlet Flange DN 40 KF for TURBOVAC 360 CSV

On the TURBOVAC 360 CSV, the DN 25 KF forevacuum outlet flange can be replaced by a DN 40 KF flange. This is recommendable especially when operating the TURBOVAC 360 CSV with purging gas or using a larger backing pump.

Standard specification
Forevacuum outlet port DN 40 KF
1 pin wrench
1 O-ring 34 x 2 mm

Fitting instructions
Place the pin wrench around the forevacuum outlet flange so that the pin is in the bore of the flange. Then turn the flange counterclockwise.

Insert the new O-ring and tighten the DN 40 KF flange clockwise with the pin wrench. Rub a little vacuum grease on the thread (Al/Al).

For Ref.No., see Section 1.3.

2 Operation

2.1 Connecting the Pump and Accessories

Important
Do not remove the packing flanges from the high-vacuum, venting, purging and forevacuum ports until just before connecting the pump to the corresponding flanges of the vacuum system so that the TURBOVAC is installed under the cleanest possible conditions.

2.1.1 Initial Charge of Oil

Prior to initial operation, the 150 CSV or 360 CSV pump must be filled with the special oil supplied (40 cm^3) (see Section 3 - Maintenance).

Note
During initial operation of the TURBOVAC filled with fresh oil, degassing of the oil lasting up to several hours will be observed. Once the prescribed forevacuum pressure has been reached, the pump may be regularly set to work, even if gas bubbles are still visible.

2.1.2 Checking the Sense of Rotation

Before installation, check the pump's sense of rotation as follows:

Connect the frequency converter to the mains by means of the linecord supplied. Then link the TURBOVAC to the frequency converter using the connecting lead supplied.

Note
The TURBOTRONIK has been set to 220 V at the factory. If it is to run on a different mains voltage, it has to be reset. Do not forget to change the mains fuse (see Operating Instructions for TURBOTRONIK).

Trial run
Press the START pushbutton (2/6) on the TURBOTRONIK; the motor will start to turn; then quickly press the STOP pushbutton (2/7).

The rotor must slowly turn clockwisse.

The sense of rotation is marked by an arrow on the pump body.

Note
The sense of rotation can only be observed through the open high-vacuum flange. The check must therefore be carried out before installing the pump.

If the sense of rotation is wrong, interchange two of the input leads in the pump's plug.

This work must only be carried out by a skilled electrician.

2.1.3 Using the TURBOVAC for Radiative, Abrasive or Reactive Media

TURBOVAC CSV turbomolecular pumps are designed for use with reactive or abrasive media; they thus have a purging gas flange (DN 10 KF, blank-flanged) as a standard feature. This purging gas flange is at the side of the TURBOVAC's base flange.

A larger backing pump necessitated under these conditions can easily be connected after replacing the forevacuum flange (see Section 1.6.7).

If the TURBOVAC is used within the reach of a magnetic field, make sure that the magnetic induction, measured at the surface of the pump jacket, does not exceed

B = 5 mT for a radial field and
B = 15 mT for an axial field.
If these valus are exceeded, suitable magnetic shielding of the pump will be necessary.

The standard pump is radiation-proof up to 10^5 rad.

We will gladly supply advice for specific applications.

2.1.4 Mounting the Pump

The TURBOVAC is high-precision balanced and operates practically free of vibration. In most cases, it is fitted directly to the high-vacuum flange of the vacuum system. Where extremely high freedom from vibration is required, the TURBOVAC can be flange-mounted with antivibration bellows.

High-vacuum connection
The pump may only be mounted vertically with at most 15° deviation from the perpendicular.

Remove the packing flange from the high-vacuum port (1/2).

For connection, make sure of absolute cleanliness.

To protect the TURBOVAC, a wire-mesh splinter guard (1/3) is installed in the high-vacuum flange.

TURBOVAC with ISO-K clamp flange
Fit the Viton O-ring without twisting to the centering ring. The O-ring should fit evenly. Then add the outer ring.

A collar flange with retaining ring and sealing disk may also be used for connecting the TURBOVAC.

When ultra-high vacuum sealing disks are used, a collar flange is needed.

Collar flange with retaining ring DN 100
Ref.No. 267 70

Sealing disk for ISO-F collar flange DN 100
Ref.No. 867 30

Ultra-high vacuum sealing disk DN 100 Ref.No. 882 70

TURBOVAC with CF flange
Copper gasket DN 100 CF Ref.No. 839 45
Bearing ring with Viton O-ring DN 100 CF
Ref.No. 839 35

Forevacuum connection
In general, a two-stage rotary-vane pump is required as backing pump to operate the TURBOVAC. We recommend our TRIVAC pumps.

Fig. 3 shows the layout for a TURBOVAC and a TRIVAC backing pump with anti-suckback valve. When using a backing pump not having an integrated anti-suckback valve, a separate safety valve must be provided. This will prevent backstreaming of oil from the backing pump when the TURBOVAC is not running. To insure that the forevacuum space of the TURBOVAC remains largely free of oil vapors during operation, too, it is advisable to install a sorption trap in the foreline.

Foreline sorption trap DN 25 KF Ref.No. 854 15
Foreline sorption trap DN 40 KF Ref.No. 854 16

Make sure that vibrations are not transmitted from the backing pump to the TURBOVAC.

2.1.5 Water Cooling

Use only clean water (tap water) to cool the TURBOVAC. If no clean water is available, a filter or fine-mesh strainer (e.g. fuel filter cartridge) should be inserted in the cooling-water line.

In such cases, the refrigerator (Ref.No. 853 39) is recommended as an alternative. The hoze nozzles (1/9) (11 mm diameter) for cooling-water connection are located at the bottom of the TURBOVAC.

Secure the connections by hose clips so that they will not slide off.

2.1.6 Air Cooling

When installing the air-cooled TURBOVAC, make sure that the fan always has an adequate air supply. Connect the fan to the 220 V or 110 V a.c. mains. The fan must always be switched on simultaneously with the TURBOVAC.

The max. ambient temperature is 35 °C for the air-cooled TURBOVAC during bakeout. Without bakeout, the pump can be used at up to 45 °C at operating pressures $< 10^{-4}$ mbar.

2.2 Startup

2.2.1 Switching On

In the case of smallish vacuum chambers, i.e. if a pressure below 1 mbar is attained within 10 minutes, the backing pump and TURBOVAC can be switched on simultaneously, after opening the cooling-water supply or turning on the air cooling. In this case, the TURBOVAC acts as an efficient baffle right from the

beginning. Large vacuum chambers must first be roughed down to a pressure of 1 to 2 mbar by the backing pump. Then switch on the water cooling and start the TURBOVAC by pressing the START pushbutton (2/6) on the TURBOTRONIK. The runup from 0 to the rated rotational speed is automatic and is signalled by the green pilot lamp "HOCHLAUF" (runup) (2/2). As soon as the rated rotational speed is reached, this pilot lamp goes out and the pilot lamp "NORMALBETRIEB" (operation) (2/3) indicates that the pump is running at its rated rotational speed.

2.2.2 Special Notes on Operation

Foreign particles which may get into the pump via its intake are likely to cause serious damage to the rotor. The pump should therefore be operated exclusively with the wire-mesh splinter guard supplied. Any damage occurring while the pump operates without splinter guard is excluded from warranty.

Sudden, heavy external vibration and blows or shocks during pump operation should be avoided. In order to attain operating pressures in the region of 10^{-8} mbar within a short time, it is recommendable to bake out the TURBOVAC for 5 to 6 hours using the bakeout jacket. When fitting the jacket, make sure that its upper rim is at the same level as the cylindrical part of the pump body.

Important
During bakeout, the temperature of the TURBOVAC's intake flange should never exceed 100 °C, and that of the rotor should not exceed 80 °C. The rotor must therefore be protected against strong, direct thermal radiation.

When baking out components on the forevacuum side (e.g. sorption trap), make sure that the temperature of the forevacuum flange of the TURBOVAC does not exceed 80 °C.

After a power failure, the TURBOVAC must be restarted. This is possible at any rotational speed. The speed at which the TURBOVAC is running at the moment of restarting is matched by the frequency converter and the pump accelerated to the rated rotational speed.

If the motor is subjected to such a high load that the speed and frequency drop below approx. 150 Hz, the TURBOTRONIK switches off and the red pilot lamp "STÖRUNG" (failure) (2/4) lights up. This failure signal is cleared by pressing the STOP pushbutton (2/7). Pull out the mains plug and find the cause of trouble (see Section 4).

2.2.3 Shutdown

Switch off the TURBOVAC by pressing the STOP pushbutton (2/7) on the TURBOTRONIK. Switch off the backing pump; on TRIVAC pumps, the anti-suckback valve closes automatically and shuts off the forevacuum line.

Before standstill of the TURBOVAC, it should be vented with dry air or dry nitrogen in order to prevent backstreaming of oil vapors from the foreline to the high-vacuum valve. Venting can be accomplished from the high-vacuum side or via the venting device (see Section 2.2.4). Immediately after switching off the TURBOVAC, turn off the cooling-water supply or the air cooling so as to avoid condensation of vapors inside the pump.

If the TURBOVAC is to be demounted from the vacuum system, the pump, having been vented with dry gas, should immediately be closed at the intake flange and at the forevacuum flange in order to avoid contamination or corrosion.

2.2.4 Venting the TURBOVAC

The 150 CSV and 360 CSV pumps can be vented to atmospheric pressure at any time, even at full rotational speed, not only via the venting flange on the pump body but also from the high-vacuum side, provided that the values of the pressure rise characteristic (Fig. 4) are taken into account.

Shock venting is possible without damage to the pump, but should only be made in exceptional cases.

The backing pump must be provided with a safety valve to prevent unintentional venting in the event of failure of the backing pump.

On no account should the switched-off TURBOVAC be left under vacuum because this causes hydrocarbon contamination.

3 Maintenance

The TURBOVAC, the solid-state frequency converter and the motor generator frequency converter require very little maintenance.

The TURBOVAC's oil should be changed after the first 500 hours of operation. If a visual check shows that the oil is dark, the oil should be changed earlier.

Further oil changes are recommended at intervals of 5,000 hours of normal operation.

Oil change
Switch off the TURBOVAC and vent it.

Then unscrew the three fastening screws on the oil pump casing (1/12) and pull off the oil chamber in a downward direction.

Clean the filter and chamber with a suitable solvent, e.g. petroleum ether, Freon TRT 113 or Degreaser ECS-SV made by Vecom, Schlenzigstr. 7, 2102 Hamburg 93.

Make sure that the oil feed bore (1/15) to the interior of the oil chamber is not clogged.

Fill the required amount of oil into the outer annular space (approx. 40 cm³) of the oil chamber.

The oil should reach the bottom mark on the oil chamber when the chamber is demounted, and the upper mark when it is mounted.

When refitting the oil chamber (see spare parts list for pump), insure that the gasket is correctly seated in the groove and that the centering ring is exactly fitted in.

When mounting the filter, make sure that it rests firmly in a central position.

The oil chamber (1/10) must fit evenly alongside the bottom flange of the pump.

Special oil 120 cm³ Ref.No. 853 28
Spare gasket for TURBOVAC 150/360 CSV
Ref.No. 200 17 451

3.1 Cleaning the TURBOVAC

If cleaning of the pump interior becomes necessary, the TURBOVAC can be disassembled in such a way that all parts are easily accessible.

Important
When disassembling, cleaning and reassembling, nothing should be changed on any parts of the rotor (1/6). The

rotor is high-precision balanced, and any change on any rotor part will necessitate rebalancing.

Disassembling the TURBOVAC
(also see spare parts list)
Drain the oil, see Section 3 - Oil change.

After draining the oil, leave the TURBOVAC for about one hour tilted slightly toward the side opposite the current leadthrough (1/7).

After the remaining oil has drained, unscrew the screws (1/13). Then screw two puller screws into the threaded holes in the flange until the casing lifts off by approx. 4 mm from the base flange. Then pull off the casing vertically upward without turning it. The stator package consists of spacer rings and blade disks.

Before disassembly, number the spacer rings with a felt-tip pen consecutively from the top to the bottom.

Carefully lift the spacer rings upward and off, turn them by 180° and lay them down. The blade disks of the stator are split and can be withdrawn laterally in a horizontal direction. Also turn them by 180° and then place them in the spacer rings.

Compile the spacer rings and blade disks in the sequence of disassembly so that the stator package is reassembled in the same sequence.

The stator package comprises blade disks with small blade angle and short blades, blade disks with large blade angle and long blades, spacer rings of small, medium or large height, and one split spacer ring with intermediate exhaust.

Clean the stator elements and the rotor with a suitable solvent. When cleaning the rotor, cleaning liquid must not enter the ball bearings; therefore, hold the pump with the rotor downward during cleaning and do not turn it back round until it is dry.

Do not alter the sequence of the spacer rings and blade disks.

Important
Make sure that the rotor blades are not bent.

Do not stand the pump back on its feet until all cleaning liquid has been removed. When cleaning the forevacuum port, the exhaust bores for the motor space should always be sealed so that cleaning liquid does not enter it.

After cleaning, reassemble the stator in the reverse sequence. The blade disks must be in abutting position, and the stator rings must lock in centrically.

The correct position of the various spacer rings and blade disks is shown in the diagram in the enclosed spare parts list.

Insure correct positioning of the spacer ring with exhaust slit. After reassembly of the stator package, mount the pump casing exactly centrically.

Only do so in the direction of mounting, i.e. toward the motor flange. Retraction or turning of the casing would cause decentering of the stator package.

Tighten firmly and uniformly the fastening screws (1/13) with washers. Make sure that the upper blade

wheel of the rotor is equidistant along its periphery from the stator elements (upper spacer ring).

A thickness gauge placed between the pump casing and the base flange during tightening has proved useful in this connection.

Check that the rotor rotates without rotor elements touching stator elements and without any perceptible resistance in the motor bearings.

Seal off the TURBOVAC with a blank flange and check the pump for tightness and proper runup.

4 Troubleshooting

The attached table is intended to facilitate systematic location and elimination of possible malfunctions.

Some of the points mentioned might seem quite obvious at first glance but should nevertheless be included in a complete checklist.

Preliminary checks
Does the TURBOVAC receive power? - Check connecting plugs.

Check water flow monitor for proper functioning.

For this check, bypass the monitor briefly and start the TURBOVAC.

Check the backing pressure; it should be lower than 10^{-1} mbar. For attaining a good ultimate pressure, a backing pressure below 5×10^{-2} mbar is required.

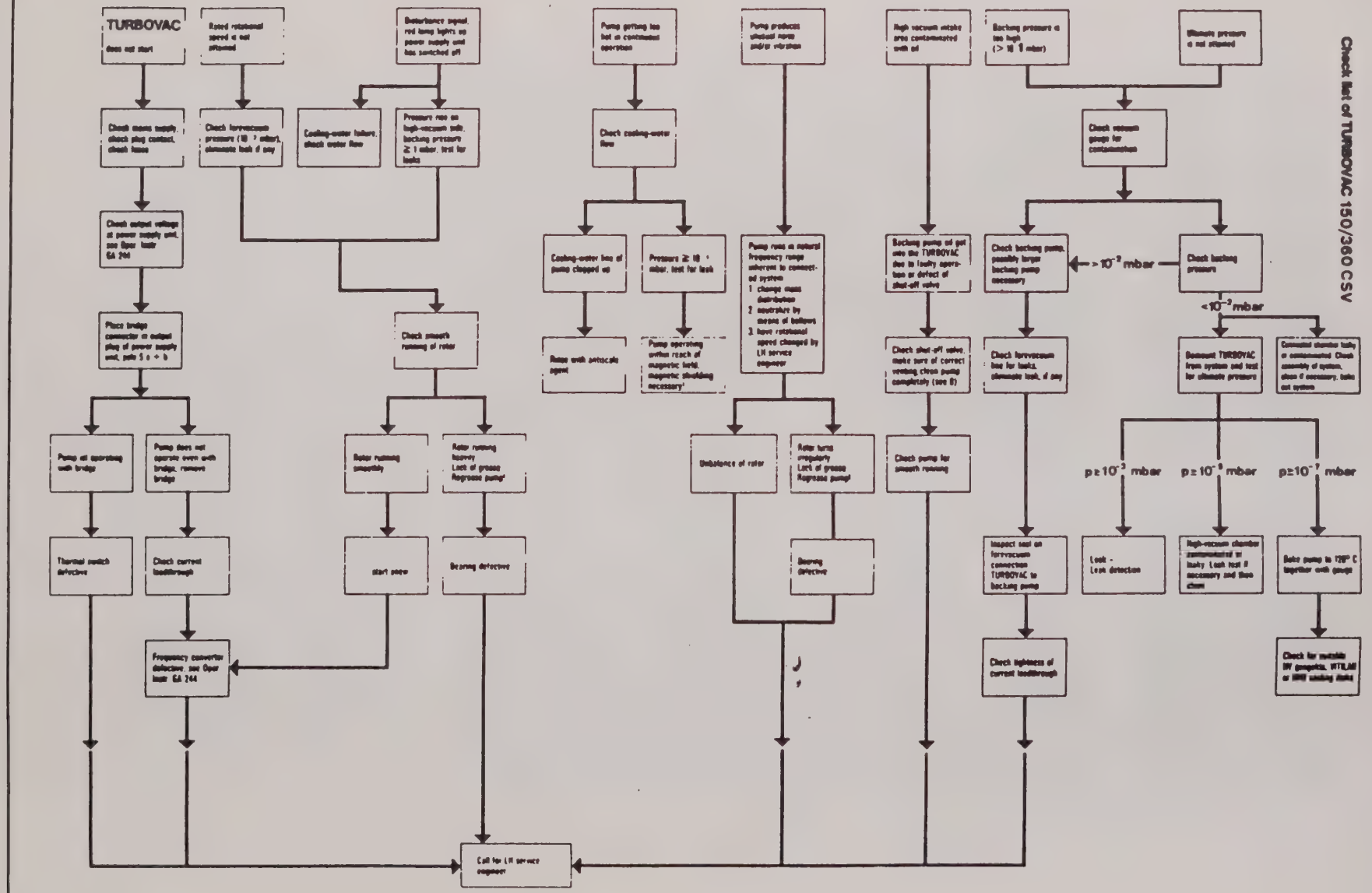
If the conditions specified so far are met, check whether the TURBOVAC or TURBOTRONIK is defective.

Turn the pump rotor of the TURBOVAC by hand and check it for smooth running. If it rotates smoothly, probably the frequency converter is defective.

Disconnect the load from the TURBOTRONIK, i.e. pull out the plug of the supply cable to the TURBOVAC, bridge pins 2 and 3 on the pump plug, and press the START pushbutton (2/6). The green pilot lamp "HOCHLAUF" (runup) (2/2) lights up briefly; after a few seconds, the frequency converter automatically changes to normal operation (pilot lamp (2/3) lights up). The output voltage at the converter between 2 phases (pins 6, 7, 8) is then approx. 42 V a.c.

If these conditions are not fulfilled, refer to the checklist in the Operating Instructions GA 238 for the TURBOTRONIK NT 150/360.

Important
When the connecting lead to the TURBOVAC 360 is plugged in, the outputs of the NT 150/360 frequency converter are not at zero potential. This must be borne in mind for measurements at the outputs of the NT 150/360.


Check list of TURBOVAC 150/360 CSV
TURBOVAC does not start
Rated rotational speed is not attained
Backing pressure is too high (> 10⁻¹ mbar)
Ultimate pressure is not attained
Pump getting too hot in continuous operation
Pump produces unusual noise and/or vibration
High vacuum chamber contaminated with oil
Check mains supply, check plug contact, check fuses
Check forevacuum pressure (10⁻¹ mbar), eliminate leak if any
Cooling-water failure, check water flow
Pressure rise on high-vacuum side, backing pressure ≥ 1 mbar, test for leaks
Check cooling-water flow
Check vacuum gauge for contamination
Check output voltage at power supply unit, see Oper. Instr. EA 244
Cooling-water line of pump clogged up
Pressure ≥ 10⁻¹ mbar, test for leak
Pump runs at natural frequency range inherent to connected system
1 change mass distribution
2 accelerate by means of bellows
3 have rotational speed changed by LH service engineer
Backing pump oil got into the TURBOVAC due to faulty operation or defect of shut-off valve
Check backing pump, possibly larger backing pump necessary
> 10⁻² mbar
Check backing pressure
< 10⁻² mbar
Place bridge connector in output plug of power supply unit, pin 5 + 6
Check smooth running of rotor
Rotor with antiscale agent
Pump operating within reach of magnetic field, magnetic shielding necessary!
Check shut-off valve, make sure of correct venting, close pump completely (see 8)
Check forevacuum line for leaks, eliminate leak, if any
Evacuate TURBOVAC from system and test for ultimate pressure
Connected chamber faulty or contaminated. Check assembly of system, clean if necessary, bake out system
Pump will operate with bridge
Pump does not operate even with bridge, remove bridge
Rotor running smoothly
Rotor running heavily Lack of grease Regrease pump!
Unbalance of rotor
Rotor turns irregularly Lack of grease Regrease pump!
Check pump for smooth running
p ≥ 10⁻³ mbar
p ≥ 10⁻⁵ mbar
p ≥ 10⁻⁷ mbar
Thermal switch defective
Check current loadthrough
start valve
Bearing defective
Bearing defective
Inspect seal on forevacuum connection TURBOVAC to backing pump
Leak - Leak detection
High-vacuum chamber contaminated or leaky Leak test if necessary and bake clean
Bake pump to 120° C together with gauge
Frequency converter defective, see Oper. Instr. EA 244
Check tightness of current loadthrough
Check for available UV gauge(s), WTELAM or WINI working diskette
Call for LH service engineer

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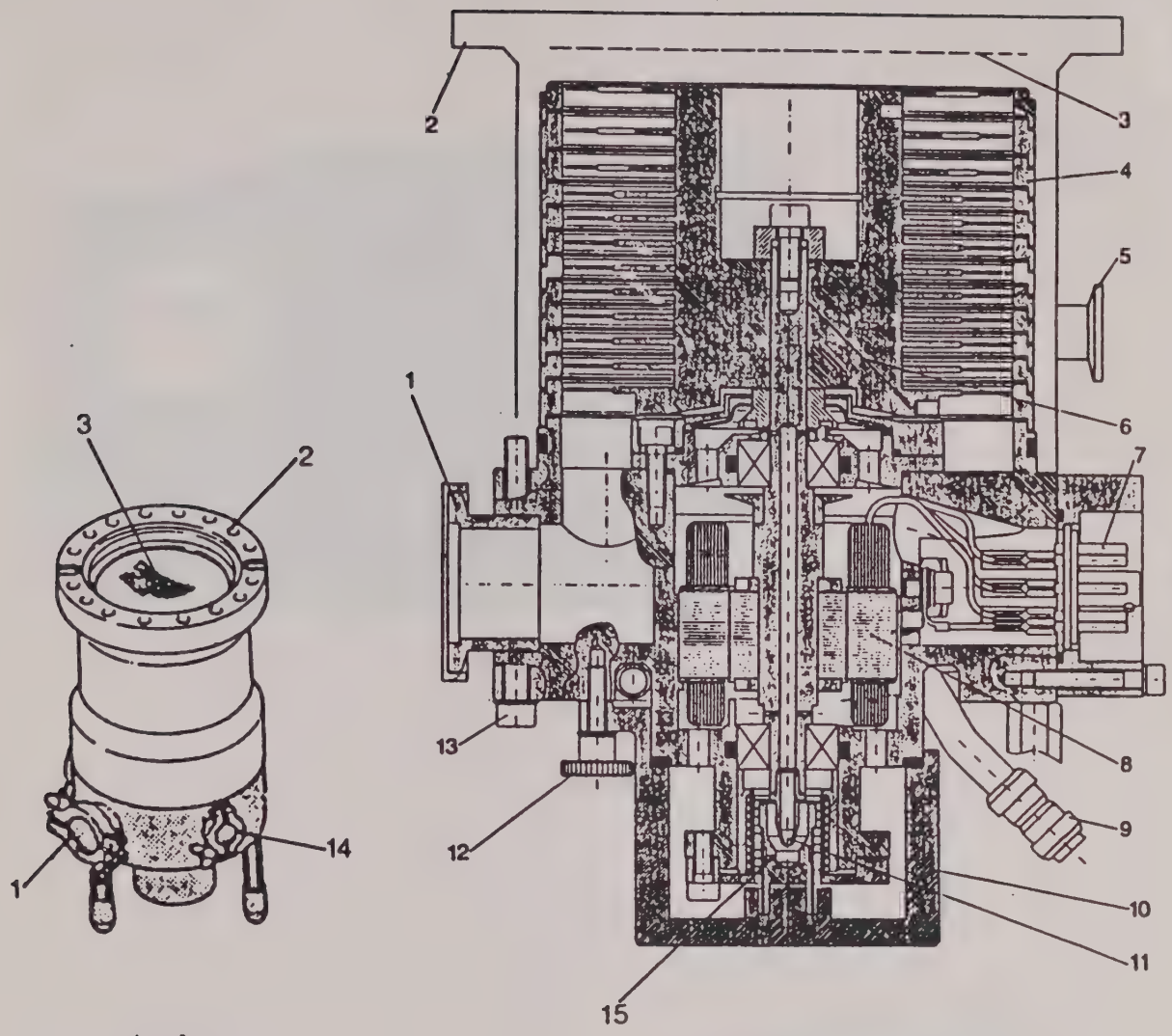
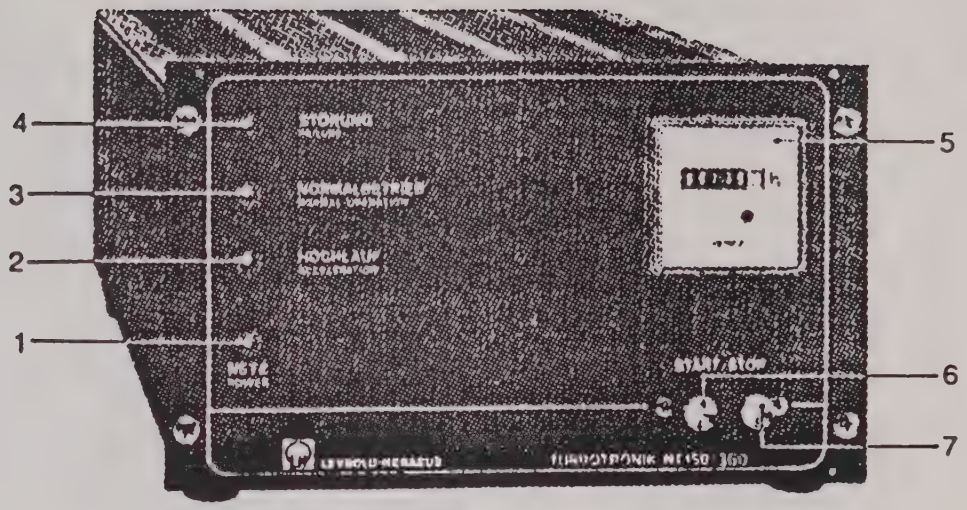


Key to Fig. 1

1 Forevacuum outlet flange
2 High-vacuum intake flange
3 Wire-mesh splinter guard
4 Stator package
5 Small venting flange
6 Rotor
7 Current leadthrough (socket)
8 Drive motor
9 Cooling-water connection
10 Special oil chamber
11 Oil pump
12 Oil-chamber fastening screw
13 Fastening screws
14 Purging-gas flange
15 Oil feed bore

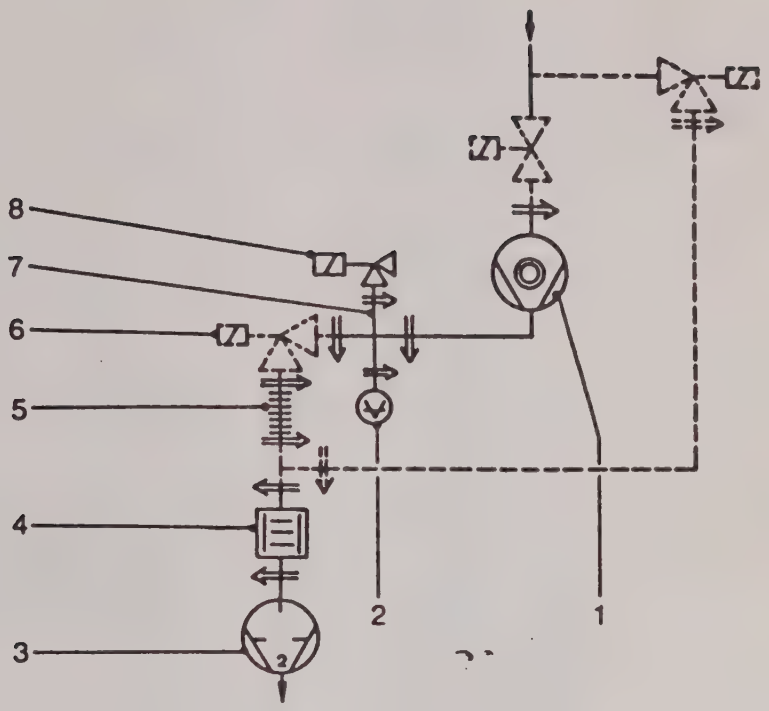
Fig. 1 TURBOVAC 150 C8V turbomolecular pump



Key to Fig. 2

1 Pilot lamp "NETZ" (mains)
2 Pilot lamp "HOCHLAUF" (runup)
3 Pilot lamp "NORMALBETRIEB" (operation)
4 Pilot lamp "STÖRUNG" (failure)
5 Operating hours counter
6 START pushbutton
7 STOP pushbutton

Fig. 2 TURBOTRONIK NT 150/360 solid-state frequency converter



Key to Fig. 3

1 TURBOVAC
2 Forevacuum gauge port
3 Backing pump
4 Sorption trap
5 Antivibration bellows
6 Shutoff valve
7 Venting port
8 Venting valve

--- Roughing line; recommendable for attaining very short pumping cycles

Fig. 3 Backing pump connection diagram

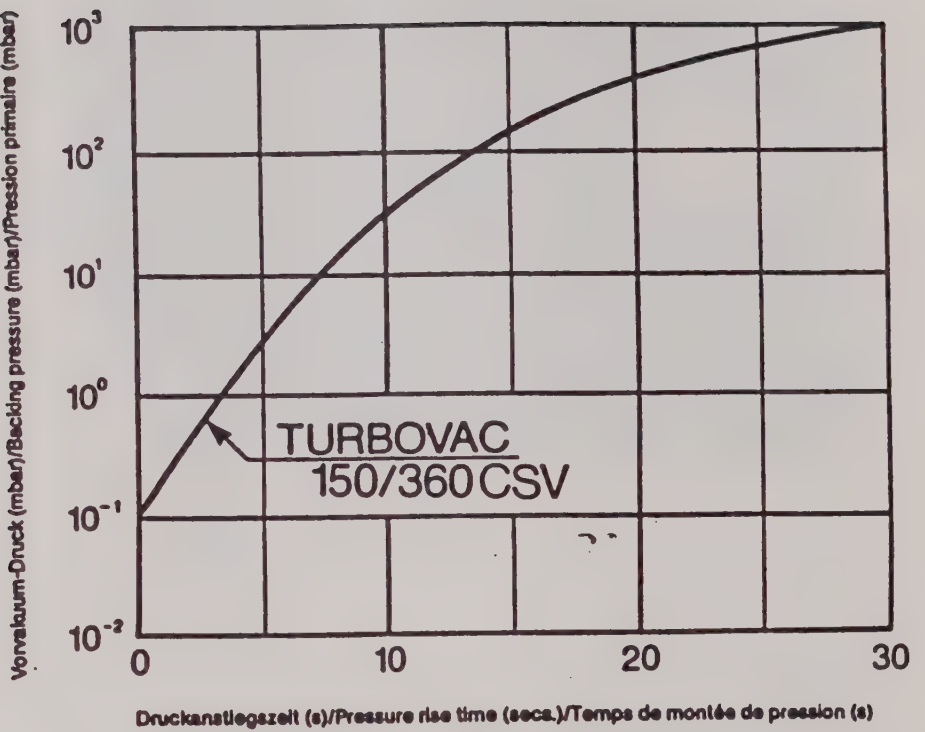


Fig. 4 Diagram for safe venting of TURBOVAC; pressure rise as a function of venting time

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TURBOTRONIK NT 150/360

Elektronischer Frequenzwandler
Solid-State Frequency Converter
Convertisseur électronique de fréquence

854 72

Gebrauchs-anweisung

SUPPLIED BY

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3 Equipement de série et construction
4 Fonctionnement
5 Raccordement et mise en service
6 Dépannage

1 Technische Daten

Netzanschluß, 50-60 Hz	100/120 V_{eff}
Umschaltbar	220/240 V ± 15 %
Leistungsaufnahme	
– im Hochlauf (max. 30 min)	680 VA
– kontinuierlich max.	480 VA
– kurzzeitig (0,5 s)	750 VA
max. Ausgangsspannung	3 x 45 V_{eff}
Überlaststrombegrenzung	3,5 A
Nennfrequenz – TMP 150	840 Hz
– TMP 360	760 Hz
zulässige Umgebungstemperatur* während des Betriebes	0 – 45 °C
Max. Belastung der Relaiskontakte** 24 V– und 240 V	8 A
Abmessungen (B x H x T)	213 x 129 x 290 mm
Gewicht	8,5 kg

Elektronischer Frequenzwandler Kat.-Nr. 854 72

*) Bei allen Geräten: zulässige Luftfeuchtigkeit entsprechend Anwendungsklausel F nach DIN 40 040 VDE-Bestimmungen 0100, 0110, 0160

**) Schaltleistung bei geeigneter Funkenlöschung. Vor Öffnen des Gerätes Netzstecker ziehen! Bei Anlegen von Fremdspannung größer 42 V an Anschlußklemmen des Gerätes VDE-Sicherheitsbestimmungen beachten!

1 Technical Data

Mains supply, 50/60 Hz, selectable	100/120 $V_{r.m.s.}$ 220/240 V ± 15 %
Power consumption	
– during acceleration (max. 30 mins.)	680 VA
– for continuous duty, max.	480 VA
– for short time (0.5 sec.)	750 VA
Max. output voltage	3 x 45 $V_{r.m.s.}$
Overload current limitation	3.5 A
Rated frequency – TMP 150	840 Hz
– TMP 360	760 Hz
Admissible ambient temperature* during operation	0 to 45 °C
Max. load of relay contacts** 24 V d.c. and 240 V	8 A
Dimensions (W x H x D)	213 x 129 x 290 mm
Weight	8.5 kg

Solid-state frequency converter Cat. No. 854 72

*) For all instruments: admissible humidity according to applicable clause F of DIN 40 040. VDE-Specifications 0100, 0110, 0160.

**) Switching power at suitable spark quenching. Pull mains plug before opening the instrument. When applying foreign voltages higher than 42 V to connecting terminals to the instrument observe the local safety regulations.

1 Données techniques

Tension secteur 50/60 Hz	100/120 V_{eff}
Commutable	220/240 V ± 15 %
Puissance absorbée	
– pendant la mise en vitesse de la pompe (max. 30 min)	680 VA
– en régime permanent, max.	480 VA
– pendant une brève durée (0,5 s)	750 VA
Tension max. de sortie	3 x 45 V_{eff}
Limitation courant de surcharge	3,5 A
Fréquence nominale – Turbo 150	840 Hz
– Turbo 360	760 Hz
Température ambiante admissible* en fonctionnement	0 – 45 °C
Charge maxi des contacts de sortie** 24 V continu et 240 V	8 A
Encombrement (l x h x p)	213 x 129 x 290 mm
Poids	8,5 kg

Convertisseur électronique de fréquence N° de cat. 854 72

*) Pour tous les appareils: humidité de l'air admissible selon clause F de la norme DIN 40 040 Règlements VDE 0100, 0110, 0160 en vigueur en R.F.A

**) Pouvoir de commutation sous condition d'une extinction appropriée des étincelles. Avant d'ouvrir l'appareil, débrancher la prise secteur! Si on applique une tension étrangère supérieure à 42 V aux bornes de connexion de l'appareil, il faut tenir compte des normes de sécurité VDE en vigueur en R.F.A

2 Verwendung

Um TURBOVAC-Pumpen auf ihre hohe Nenndrehzahl zu bringen und zu halten, muß der eingebaute Drehstrom-Asynchronmotor aus einer dreiphasigen Spannungsquelle entsprechend hoher Frequenz gespeist werden.

Die elektronischen Frequenzwandler formen die einphasige Wechselspannung des speisenden Netzes in eine dreiphasige Wechselspannung mit verstellbarer Spannung und Frequenz um. Der Frequenzwandler wird zwischen Netz und Pumpe eingeschaltet.

2 Application

For attaining and maintaining the high rotational speed of TURBOVAC pumps the built-in three-phase asynchronous motor must be powered by a suitable high-frequency three-phase power supply.

The solid-state frequency converter converts the single phase a.c. voltage of the mains supply into a three-phase a.c. voltage with variable magnitude and frequency. The frequency converter is connected between power point and pump.

2 Utilisation

Pour atteindre et maintenir la vitesse nominale élevée des pompes TURBOVAC, il faut que le moteur triphasé asynchrone incorporé soit alimenté par une source de tension triphasée de haute fréquence appropriée.

Les convertisseurs électroniques de fréquence convertissent la tension alternative monophasée du réseau d'alimentation en tension alternative triphasée variable à fréquence réglable. Le convertisseur est monté entre le réseau et la pompe.

3 Lieferumfang und Aufbau

Die Frequenzwandler sind mit Netzanschlußleitungen ausgerüstet. Sie werden als Tischgeräte ausgeliefert und sind auf Netzanschlußspannung 220 V eingestellt. Zum Lieferumfang des Gerätes gehören jeweils eine Netzsicherung für 100/110 V und 220/240 V, Netzleitung und Pumpenanschlußleitung, 5 m lang.

Auf der Frontplatte der Geräte sind angeordnet:

Die Drucktaster „START" und „STOP" und die LED's
Netz (gelb);
Hochlauf (grün);
Normalbetrieb (gelb);
Störung (rot);
sowie der Betriebsstundenzähler.

3 Standard Specification and Design

The frequency converters are equipped with mains leads. They are housed in free standing cabinets and are set for a mains voltage of 220 V. The standard equipment includes one mains fuse for 100/110 V and one mains fuse for 220/240 V, mains lead and a connecting lead to the pump.

On the front panel of the instrument are:

START and STOP push buttons and the following LEDs:
Mains power (yellow)
Acceleration (green)
Normal operation (yellow)
Failure (red)
and the elapsed hour meter.

On the rear panel are:
Mains lead with mains fuse and

3 Equipement de série et construction

Les convertisseurs de fréquence sont des appareils de table. Ils sont réglés pour une tension secteur de 220 V. La fourniture comprend un fusible secteur pour 100/110 V et pour 220/240 V, le cordon secteur et le câble de connexion à la pompe (5 m de long).

Le panneau frontal comporte:

Les poussoirs »START« et »STOP« pour mise en/hors circuit;
les voyants Netz = secteur (jaune)
Hochlauf = mise en vitesse (vert)
Normalbetrieb = régime normal (jaune)
Störung = perturbation (rouge);
le compteur d'heures de fonctionnement.

A l'arrière se trouvent le cordon et le fusible secteur ainsi que la plaquette de commutation de tension.

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Auf der Rückseite befinden sich:
Netzanschlußleitung mit Netzsicherung und Spannungswahlkarte;
Steckbuchse für Verbindungsleitung zur Pumpe;
Klemmleiste für Fernbedienung „START – STOP";
Meldekontakt „NORMALBETRIEB";
Erdungsschraube.

voltage.selector board
Socket for connecting lead to the pump
Terminal strip for START/STOP remote control
Signal output "NORMAL OPERATION"
Ground connection screw

Fiche femelle pour câble de connexion à la pompe
Réglette de bornes pour télécommande MARCHE – ARRÊT
Contact de signalisation RÉGIME NORMAL
Vis de terre.

4 Funktionsbeschreibung

Der elektronische Frequenzwandler NT 150/360 formt die einphasige Wechselspannung des Netzes in eine dreiphasige Wechselspannung mit verstellbarer Spannung und Frequenz um.

Der Frequenzwandler ist ein fremdgesteuerter Drehstrom-Transistorwechselrichter, der im wesentlichen aus sechs Transistorschaltern besteht. Die Transistorschalter werden derart angesteuert, daß sich am Ausgang R, S, T ein Drehstromsystem bildet. Die zu den Transistoren antiparallel geschalteten Dioden können Energie vom angeschlossenen Verbraucher in den Gleichstromzwischenkreis zurückführen.

Nach Betätigen der Start-Taste wird die Spannung U_{ZK} im Gleichstromzwischenkreis nach einer IU-Kennlinie geregelt. Der Strom I und die Spannung U_{ZK} sind dem Motorstrom I_M und der Motorspannung U_M proportional. Die Frequenz der dreiphasigen Ausgangsspannung wird von einem eingestellten Minimalwert in Abhängigkeit der Gleichstromzwischenkreisspannung U_{ZK} bis zu einem

4 Operation

The TURBOTRONIK NT 150/360 solid-state frequency converter converts the single-phase a.c. voltage of the mains supply into a three-phase a.c. voltage with variable voltage and frequency.

The frequency converter is an externally controlled three-phase transistor-rectifier consisting mainly of six transistor switches. These transistor switches are controlled so that a three-phase connection is formed at the output R, S, T. The diodes connected in antiparallel to the transistors can return energy from the connected consumer into the intermediate d.c. circuit.

After depressing the "START" push button, the voltage U_{ZK} in the d.c. intermediate circuit is controlled according to an IU characteristic. Current I and voltage U_{ZK} are proportional to motor current I_M and motor voltage U_M. The frequency of the three-phase output voltage is varied from a preset minimum value, as a function of the d.c. intermediate circuit voltage U_{ZK}, up to a preset max. value.

4 Fonctionnement

Le convertisseur électronique de fréquence NT 150/360 convertit la tension alternative monophasée du réseau d'alimentation en tension alternative triphasée variable à fréquence réglable.

Il s'agit d'un inverseur transistorisé triphasé consistant essentiellement en 6 interrupteurs à transistors excités de telle façon qu'un circuit triphasé s'établit à la sortie R, S, T. Les diodes en montage antiparallèle aux transistors peuvent ramener de l'énergie prélévée du circuit consommateur dans le circuit intermédiaire de courant continu.

Après actionnement de la touche MARCHE, la tension U_{ZK} est réglée dans le circuit intermédiaire de courant continu selon une courbe caractéristique IU. L'intensité I et la tension U_{ZK} sont proportionnelle au courant I_M et à la tension U_M du moteur. La fréquence de la tension de sortie triphasée est variée en fonction de la tension U_{ZK} du circuit intermédiaire de courant continu d'une valeur minimale ajustée à une valeur maximale ajustée.

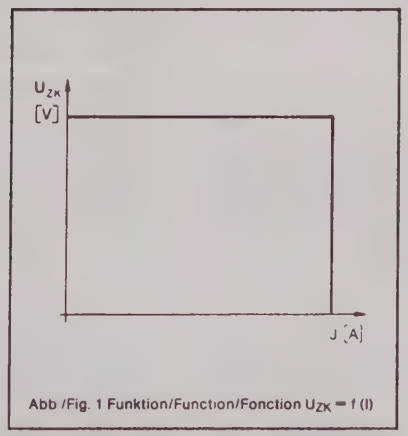

Abb /Fig. 1 Funktion/Function/Fonction $U_{ZK} = f(I)$

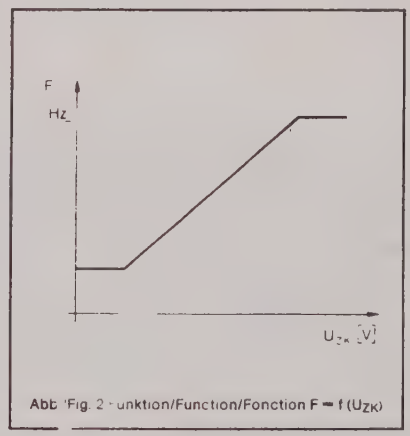

Abb /Fig. 2 Funktion/Function/Fonction $F = f(U_{ZK})$

eingestellten Maximalwert verändert.

Durch die Frequenzsteuerung $f = f(U_{ZK})$ wird der Pumpenmotor mit konstantem Schlupf optimal auf seine Nenndrehzahl beschleunigt. Die Nenndrehzahl wird durch die maximale Wandlerfrequenz bestimmt.

Der Startvorgang kann auch problemlos bei einer noch rotierenden Turbo-Molekularpumpe erfolgen. Der Frequenzwandler unterscheidet automatisch, welche Pumpe angeschlossen ist (TURBOVAC 150 bzw. 360) und stellt die entsprechende Drehfrequenz ein. Es können Verbindungsleitungen bis zu 100 m Länge verwendet werden, ohne daß Eingriffe in den Frequenzwandler erforderlich sind (siehe Abschnitt 5.4). Das Gerät

The pump motor is optimally accelerated, with constant slip, to its rated rotational speed which is determined by the maximum converter frequency.

Starting is also possible without problem with a still rotating turbomolecular pump. The frequency converter distinguishes automatically which pump is connected (TURBOVAC 150 or 360) and adjusts the corresponding rotational speed. Connecting leads up to 100 m length can be used without having to interfere with the frequency converter (see Section 5.4). The required voltage corrections for compensating line losses and maintaining the maximum output power are made automatically by the instrument.

La commande en fréquence $f = f(U_{ZK})$ assure l'accélération optimale à glissement constant du moteur de la pompe à sa vitesse nominale. La vitesse nominale est déterminée par la fréquence maxi du convertisseur.

On peut redémarrer sans problème même si la pompe turbomoléculaire tourne encore. Le convertisseur »identifie« automatiquement la pompe raccordée (TURBOVAC 150 ou 360) et ajuste le nombre de tours correspondant. On peut utiliser des câbles de connexion jusqu'à 100 m de long sans avoir à procéder à un équilibrage dans le convertisseur (voir 5.4). L'appareil corrige automatiquement la tension nécessaire pour compenser les pertes de ligne et maintenir la puissance de sortie maxi.

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führt die zur Kompensation der Leitungsverluste und zur Aufrechterhaltung der maximalen Ausgangsleistung erforderlichen Spannungskorrekturen automatisch aus.

Der Frequenzwandler ist an seinen Ausgängen kurzschlußfest.

Durch Verwendung einer hoch integrierten Schaltung wurde die Konzentration zahlreicher Funktionen in einem Bauteil ermöglicht. Dieses Bauteil erzeugt alle Steuerfunktionen und auch praktisch alle Überwachungs- und automatischen Prüffunktionen. Kontrolliert werden z. B. die Ausgangsspannung, Drehfrequenz und Zwischenkreisspannung sowie deren exakte Relationen zu jedem Betriebszeitpunkt. Die hoch integrierte Schaltung verfügt außerdem über Selbsttesteigenschaften. Diese Eigenschaften ermöglichen die Überprüfung von Baugruppen oder bei Betriebsstörung eine schnelle Fehlereinkreisung.

Zwei Selbsttest-Eigenschaften sind im NT 150/360 eingebaut.

Die dynamische Prüfung erfolgt kontinuierlich während des Betriebes und zeigt die Feststellung und Art einer Störung an. Weitere Erläuterungen siehe Abschnitt 6 – Fehlerhinweise.

Die statische Prüfung wird bei eingeschaltetem Wandler und nicht angeschlossener Pumpe durchgeführt. Die hoch integrierte Schaltung besitzt ein Selbsttestprogramm mit 6 Unterprogrammen, die einzeln abgerufen werden können. Eine ausführliche Beschreibung des NT 150/360 zur Fehlersuche und Erläuterung der Prüfprogramme gibt es in englischer Sprache.

The frequency converter is short-circuit-proof at its outputs.

The use of highly integrated circuitry permits concentration of numerous functions in one component. It produces all control functions and also virtually all monitoring and automatic test functions. For example, output voltage, rotational speed and intermediate-circuit voltage and their precise interrelationships are monitored at any time of operation. Furthermore, the highly integrated circuitry provides self-testing which enables testing of component groups or, in case of failure, quick fault location.

Two self-testing possibilities are provided in the NT 150/360:

Dynamic checking is made continuously during operation and indicates the detection and type of failure. For further explanations refer to Section 6 'Trouble Shooting'.

Static checking is made with converter switched on and pump disconnected. The highly integrated circuit has a self-testing program with 6 subroutines which can be called off separately. A detailed description of the NT 150/360 for trouble shooting and explanation of the test program, in English language, is available.

Les sorties du convertisseur de fréquence sont résistantes aux court-circuits.

L'application d'un circuit hautement intégré permet de concentrer en une seule unité un grand nombre de fonctions. Cette unité engendre toutes les fonctions de commande et pratiquement toutes les fonctions de surveillance et de contrôle automatique. Exemple: contrôle de la tension de sortie, du nombre de tours, de la tension du circuit intermédiaire et de leurs relations exactes à tout moment du service. On peut ainsi vérifier des ensembles ou localiser rapidement l'origine d'une panne.

Le NT 150/360 comporte deux contrôles automatiques:

le contrôle par exploration en continu pendant le fonctionnement, révèlant la présence et la nature d'une perturbation. Vous trouverez de plus amples détails au § 6;

le contrôle statique effectué convertisseur en circuit, pompe déconnectée. Le circuit intégré possède un programme de contrôle automatique avec 6 sous-programmes pouvant chacun être appelés sélectivement. Vous trouverez une description détaillée du NT 150/360 avec un plan de dépannage et l'explication des programmes de contrôle dans une brochure en anglais.

5 Anschluß und Inbetriebnahme

5.1 Einstellung auf Netzspannung

Die Frequenzwandler werden anschlußfertig für Netzspannung 220 V, 50/60 Hz ausgeliefert. Bei abweichender Netzspannung erfolgt die Spannungswahl und der Sicherungswechsel von der Rückseite des Gerätes aus. Der Spannungs- oder Sicherungswechsel kann nur bei gezogenem Netzstecker erfolgen.

Spannungswahl:
Die Leiterplatte, auf der die vier Spannungen aufgedruckt sind, wird so in den Steckanschluß unter die Sicherung eingesetzt, daß nach dem Einschieben die korrekte Netzspannung lesbar ist.

Sicherung:
Die Sicherungen können direkt eingesetzt bzw. entfernt werden durch Herausziehen an der bezeichneten Vorrichtung. Bei Anschluß an 120 V ist die mitgelieferte Netzsicherung 3 AG 10 A einzusetzen.

5.2 Aufstellung

Bei Aufstellung oder Einbau ist darauf zu achten, daß der Kühlluftstrom durch das Gerät nicht behindert wird. Die max. Umgebungstemperatur von 45°C darf nicht überschritten werden.

5.3 Anschluß von TURBOVAC und TURBOTRONIK

Vor Einstecken des Netzsteckers zunächst den Anschluß an die TURBOVAC vornehmen.

5 Connection and Initial Operation

5.1 Adjustment of mains voltage

The frequency converters are supplied ready for connection to 220 V, 50/60 Hz mains voltage. Where mains power is different, voltage selection and change of fuse are on the instrument rear. Always disconnect the mains plug before doing this work.

Voltage selection:
Insert the p. c. board, onto which four voltages are imprinted, into the plug connection below the fuse so that after insertion the correct mains voltage is read off.

Fuse:
The fuses can be directly inserted or removed at the marked point. When selecting 120 V mains supply, insert the 3 AG 10 A fuse included in the standard equipment.

5.2 Setting-up

When setting up or installing the converter, make sure not to obstruct cooling by natural air circulation. The max. ambient temperature of 45°C must not be exceeded.

5.3 Connection of TURBOVAC and TURBOTRONIK

At first, connect to the TURBOVAC before plugging in the mains plug. If the unit is not

5 Raccordement au réseau et mise en service

5.1 Réglage de la tension secteur

Les convertisseurs sont normalement livrés pour usage en 220 V, 50/60 Hz. Pour les autres tensions commutables: ne pas raccorder l'appareil; la plaquette C.I. et le fusible à changer sont accessibles par l'arrière.

Tension:
permuter sur la tension désirée le petit circuit imprimé enfichable se trouvant sous le fusible: repère: placer le C.I. de façon à lire la tension secteur désirée.

Fusible:
extraire le fusible en tirant sur le porte-fusible. En 120 V il faut le remplacer par le fusible 3 AG 10 A compris dans la livraison.

5.2 Mise en place

La circulation d'air ne doit jamais être gênée. La température ambiante ne doit pas dépasser 45°C au maximum. En tenir compte à l'installation ou l'encastrement du coffret.

5.3 Raccordement TURBOTRONIK – TURBOVAC

Le convertisseur doit être raccordé à la pompe avant d'être branché au réseau.

Wenn keine Fernsteuerung vorgesehen ist, muß an der Steuerklemmleiste Klemme 2 mit Klemme 3 gebrückt sein (siehe Abb. 3). Zum Anschluß der Fernsteuerung siehe Abb. 4 und 5. Die Spannung an den Fernsteuerkontakten beträgt max. 30 V Gleichspannung.

5.4 Inbetriebnahme

Bitte beachten Sie zuvor die Hinweise zur Inbetriebnahme der TURBOVAC in der zugehörigen Gebrauchsanweisung.

Nach Einstecken des Netzsteckers laufen im Wandler verschiedene Initialisierungen und Selbstprüfvorgänge ab, bevor die Startbefehle akzeptiert werden. In dieser Betriebsphase leuchten alle vier LED's an der Frontplatte auf und es werden folgende P .nkte ermittelt:

angeschlossener Pumpentyp (TURBOVAC 150 oder 360);
verwendete Leitungslänge (max. 100 m);
Eigentest der Baugruppen.

Die Phase der Initialisierungen und Selbstprüfvorgänge dauert nur wenige Sekunden. Nach Beendigung erlöschen alle LED's bis auf die Netzanzeige und der Hochlauf kann mit dem Start-Befehl beginnen. Nach Betätigung der Start-Taste leuchtet die grüne LED „HOCHLAUF" und die TURBOVAC beginnt zu rotieren. Hat die Pumpe 80 % der Nenndrehzahl überschritten, erlischt die Hochlaufanzeige und die Normalbetrieb-LED leuchtet auf (Hochlaufzeit TURBOVAC 150 etwa 1,5 min; TURBOVAC 360 etwa 3 min).

Gleichzeitig mit „NORMALBETRIEB" wird

to be used for remote control, terminal 2 and terminal 3 on the terminal strip must be bridged (see Fig. 3). For remote control connection refer to Figs. 4 and 5. The voltage across the remote control contacts amounts to 30 V d.c. max.

5.4 Initial operation

At first, please observe the instructions for initial operation of the TURBOVAC in the respective Operating Instructions.

After plugging in the mains plug, various initiating and self-testing processes take place in the converter before the starting command can be accepted. In this operational phase all four LEDs on the front panel light up and the following points are determined:

connected pump type (TURBOVAC 150 or 360)
cable length used (max. 100 m)
self-test of component groups.

The initialization and self-testing procedure takes a few seconds only. After termination all LEDs are extinguished except the mains indicator, and run-up can start by giving the "START" command. After depressing the "START" button the green LED "ACCELERATION" lights up and the TURBOVAC starts to rotate. When the pump has exceeded 80% of its rated speed, the "ACCELERATION" indicator goes out and the LED "NORMAL OPERATION" lights up. (Acceleration time TURBOVAC 150 approx. 1.5 mins., TURBOVAC 360 approx. 3 mins.).

Simultaneously with the signal "NORMAL

1) Sans télécommande: ponter les bornes 2 et 3 (bornier; fig. 3)
2) Avec télécommande: voir fig. 4 et 5. Tension maxi aux contacts: 30 V continu.

5.4 Mise en circuit

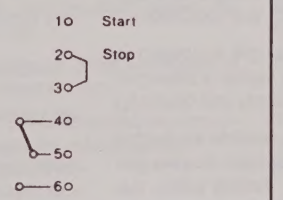
Veuillez en premier vous reporter aux instructions données dans la notice d'emploi de la TURBOVAC.

Quand on branche le convertisseur sur secteur, différents processus d'initialisation et d'auto-contrôle précèdent l'acceptation de la commande départ. A ce stade, les quatre voyants du panneau avant sont allumés et le convertisseur identifie

le type de pompe raccordé (TURBOVAC 150 ou 360)
longueur du câble (max. 100 m)
auto-contrôle des composants.

La phase d'initialisation et d'auto-contrôle ne dure que quelques secondes, après quoi les voyants, à l'exception du voyant secteur, s'éteignent; la mise en vitesse peut commencer dès que le signal départ est transmis.

Appuyer sur le bouton de démarrage; le voyant HOCHLAUF (mise en vitesse) s'allume et la TURBOVAC commence à tourner. Quand elle atteint 80% de sa vitesse nominale, le voyant de mise en vitesse s'éteint et le voyant NORMALBETRIEB (régime normal) s'allume. Durée de mise en vitesse: TURBOVAC 150: env. 1,5 min; TURBOVAC 360: env. 3 min.

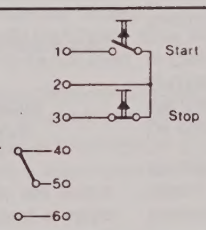


Auslieferungszustand. Betätigung durch Tasten auf Frontplatte

State when delivered. Control by push buttons on front panel

Commande par boutons poussoirs sur le panneau frontal (Etat de livraison)

Abb./Fig. 3

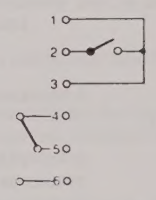


Zusätzliche Fernsteuerung durch externe Tasten

Additional remote control by external push buttons

Télécommande supplémentaire par boutons poussoirs extérieurs

Abb./Fig. 4



Fernsteuerung durch Dauerkontakt (z. B. für automatischen Wiederanlauf nach Stromausfall oder Drucksteuerung)

Remote control by switch (e. g. for automatic restarting after mains failure or pressure-control)

Télécommande par contact fermé en continu (p. ex. pour redémarrage automatique après panne secteur ou pour commande par manomètre)

Abb./Fig. 5

ein Relais geschaltet, dessen potentialfreier Kontakt auf die rückseitige Klemmleiste, Klemmen 4, 5, 6 geführt ist. Der Frequenzwandler kann bei beliebigem Betriebszustand gestartet werden.

Achtung:
Die gesamte Hochlaufphase des Wandlers soll eine Dauer von 30 min (z. B. mehrmaliges Starten) nicht überschreiten. Danach darf der Frequenzwandler erst nach Ablauf von 25 min erneut in die Hochlaufphase eintreten.

Die LED „STÖRUNG" leuchtet bei Fehlerabschaltung auf und das Relais am Meldekontakt „NORMALBETRIEB" auf der Rückseite der TURBOTRONIK fällt ab. Der Frequenzwandler wird automatisch auf „STOP" geschaltet.

OPERATION" a relay is energized whose independent contact is wired up to the rear-side terminal strip, terminals 4, 5, 6. The frequency converter can be started in any operational state of the pump.

Note:
The total acceleration period of the converter should not exceed 30 mins. (e.g. repeated starting). Thereafter acceleration of the frequency converter should not be started again before 25 mins. have elapsed.

The LED "FAILURE" lights up in the event of shut-down due to a fault and the relay of signal contact "NORMAL OPERATION" on the TURBOTRONIK rear is de-energized. The frequency converter is automatically switched to "STOP".

En même temps que l'application du signal régime normal, un relais est excité; le contact autonome de ce relais est connecté aux bornes 4, 5, 6 du bornier arrière. Le convertisseur peut être mis en circuit dans n'importe quel état de fonctionnement.

Attention:
La phase totale de mise en vitesse du convertisseur ne doit jamais dépasser 30 min (par ex. démarrages répétés). Ensuite, il faut attendre 25 min pour le remettre en accélération.

En cas d'arrêt accidentel, le voyant STÖRUNG (panne) s'allume et le contact de signalisation régime normal (à l'arrière du TURBOTRONIK) retombe. Le convertisseur est remis automatiquement sur STOP.

Die verschiedenen Störungsursachen werden durch unterschiedliche Blinkfrequenzen der LED „STÖRUNG" angezeigt.

6 Fehlerhinweise

Nachfolgend werden mögliche Fehler und deren Identifikation beschrieben.

6.1 Nach Einschalten der Netzspannung bleiben alle LED's aus

Netzspannung fehlt.
Gerätesicherung defekt.
Ursachen für defekte Gerätesicherung:
die Spannungswahlkarte ist nicht so installiert, daß sie mit der benutzten Netzspannung übereinstimmt;
falsche Sicherungsstärke;
Kurzschluß im Gleichrichterteil des N :tzgerätes;
Kurzschluß des Netztransformators.

6.2 Nach Einschalten der Netzspannung und beendeter Initialisierungsphase leuchten alle LED's außer der Netzanzeige nacheinander zyklisch auf

Die Verbindung TURBOTRONIK und TURBOVAC wurde erst nach Anlegen der Netzspannung hergestellt. Der Wandler befindet sich im statischen Selbstprüfbetrieb. Netzspannung für ca. 1 min unterbrechen.

Dynamische Selbstprüfung wurde nicht bestanden:
a) Defekt der hoch integrierten Schaltung;
b) Defekter A/D-Chip.

Unterbrechung der Verbindungsleitung Frequenzwandler/Pumpe.

The different causes of failure are indicated by different flashing frequencies of the LED "FAILURE".

6 Trouble Shooting

In the following, possible failures and their location are described.

6.1 After switching on the mains supply, the LEDs do not light up

No mains supply voltage available.
Instrument fuse blown.
Cause for blown fuse:
The voltage selector board is incorrectly inserted, i. e. does not agree with the mains voltage used.
Wrong fuse rating.
Short-circuit in rectifier section of control unit.
Short-circuit of mains transformer.

6.2 After switching on the mains voltage and termination of the initialization phase all LEDs except the mains indicator light up cyclically

Connection between TURBOTRONIK and TURBOVAC was made only after connecting the mains supply. The converter is in static self-testing operation. Interrupt the mains supply for approx. 1 min.

Dynamic self-testing unsuccessful:
a) Defect in highly integrated circuit.
b) Defective A/D chip.

Connection line between frequency converter and pump open-circuit.

La fréquence de clignotement du voyant STÖRUNG varie en fonction de l'origine de la perturbation signalée.

6 Dépannage

Liste de pannes possibles; identification.

6.1 Alimentation secteur insérée, mais aucun voyant ne s'allume

Panne de secteur.
Fusible de l'appareil brûlé.
Causes possibles:
le C.I. sélecteur de tension n'est pas bien installé de sorte qu'il ne coïncide pas avec la tension secteur.
le fusible n'a pas l'intensité voulue.
court-circuit dans le redresseur du bloc d'alimentation
court-circuit au transfo secteur.

6.2 Alimentation secteur insérée, phase d'initialisation terminée: les voyants – à l'exception du voyant secteur – s'allument tous à tour de rôle (répétition cyclique)

La connexion TURBOTRONIK – TURBOVAC n'a été faite qu'après l'enclenchement de l'alimentation secteur, de sorte que le convertisseur est en régime de contrôle statique. Couper le secteur env. 1 min.

Le contrôle dynamique (par exploration) a été négatif.
a) Défaut dans le circuit intégré
b) Chip alternatif/continu défectueux

Rupture dans le câble convertisseur-pompe.

6.3 Nach Betätigen der Taste „START" leuchtet die LED „HOCHLAUF" nicht, die Pumpe läuft nicht an

Die Brücke Klemmen 2 – 3 der Klemmleiste auf der Geräterückwand fehlt;

Bei externen Start/Stop-Tasten ist der Stromkreis über die Stoptaste unterbrochen.

6.4 Nach Betätigen der Taste „START" leuchtet die LED „HOCHLAUF" und die Störungsanzeige blinkt mit 2 Hz

Der Thermoschalter der Pumpe hat geöffnet.

6.5 Die LED „STÖRUNG" leuchtet etwa 10 Minuten nach dem Start auf

Die Pumpendrehzahl ist zu niedrig (80% der Nenndrehzahl). Es liegt ein Fehler im Vakuumsystem vor (siehe GA zur TURBOVAC, Abschnitt Störung und deren Beseitigung).

6.6 Die Störungsanzeige leuchtet während des Hochlaufes oder Normalbetriebes auf.

6.6.1 Dauerleuchten der Störungsanzeige

Kurzschluß am Ausgang. Zur Wiedereinschaltung muß die Netzspannung kurzzeitig unterbrochen werden.

6.6.2 Blinkgeschwindigkeit 1 Hz

Überlastung der Pumpe
Die Pumpendrehzahl ist zu niedrig (< 150 Hz). Es liegt ein Fehler im Vakuumsystem vor

6.3 After pressing the "START" push button the LED "ACCELERATION" does not light up, the pump does not start

The bridge across terminals 2 to 3 on the terminal strip on instrument rear is missing.

In case of external START/STOP push buttons the circuit is interrupted via the STOP push button.

6.4 After pressing the START push button the LED "ACCELERATION" lights up and the "FAILURE" indicator flashes with 2 Hz

The thermal switch of the pump has opened.

6.5 The LED "FAILURE" lights up approx. 10 minutes after starting

The pump rotational speed is too low (below 80% of rated speed). There is a fault in the vacuum system (refer to Operating Instructions for TURBOVAC, Section 'Trouble Shooting').

6.6 The LED "FAILURE" lights up during acceleration or normal operation

6.6.1 Continuous lighting of "FAILURE" indicator

Short-circuit at output. Before switching on again, interrupt mains voltage for a short time.

6.6.2 Flashing frequency 1 Hz

Overload of pump.
The pump rotational speed is too low (< 150 Hz). There is a fault in the vacuum system

6.3 Bouton »START« enfoncé: le voyant HOCHLAUF ne s'allume pas; la pompe ne démarre pas

les bornes 2 – 3 ne sont pas pontées (bornier arrière).

Les connexions électriques des boutons de mise en et hors circuit externes sont coupées par le bouton STOP.

6.4 Bouton »START« enfoncé: le voyant HOCHLAUF est allumé mais le voyant STÖRUNG clignote à une fréquence de 2 Hz

Thermorupteur de la pompe ouvert.

6.5 Environ 10 minutes après le démarrage, le voyant STÖRUNG s'allume

Vitesse de la pompe insuffisante (80% de la vitesse nominale). Défaut dans le système de vide (voir notice d'emploi de la TURBOVAC, § Perturbations/Remèdes).

6.6 Signalisation d'une perturbation pendant la mise en vitesse ou en régime normal

6.6.1 Le voyant STÖRUNG reste allumé en permanence

court-circuit à la sortie. Avant la remise en circuit, couper brièvement la tension secteur.

6.6.2 Le voyant STÖRUNG clignote à une fréquence de 1 Hz

Surcharge de la pompe.
Vitesse de la pompe insuffisante (< 150 Hz).

(siehe GA zur TURBOVAC, Abschnitt Störung und deren Beseitigung). Quittierung des Störungssignales durch Drücken der Taste „STOP".

6.6.3 Blinkgeschwindigkeit 2 Hz

Übertemperatur der Pumpe
Der Thermoschalter in der Pumpe hat geöffnet. Die Wasser- oder Luft-Kühlung ist ausgefallen. Nach Wiederherstellung einer ausreichenden Kühlung das Störungssignal durch Drücken der TASTE „STOP" quittieren.

6.6.4 Blinkgeschwindigkeit 4 Hz

Der Fehler ist im Frequenzwandler zu suchen.

Hinweis
Lassen sich Fehler mit den Hinweisen in den Abschnitten 6.1 bis 6.6 nicht beseitigen, bitte LH-Kundendienst anfordern. Außerdem ist ein englischsprachiges Service-Manual erhältlich zur Fehlersuche und Erläuterung der Prüfprogramme.

(see Operating Instruction for TURBOVAC, Section 'Trouble Shooting'). The fault signal is cancelled by pressing the "STOP" button.

6.6.3 Flashing frequency 2 Hz

Overtemperature of pump.
The thermal switch in the pump has opened. Water or air cooling failure. After reestablishing adequate cooling conditions, cancel the fault signal by depressing the "STOP" button.

6.6.4 Flashing frequency 4 Hz

Fault is to be found in the frequency converter.

Note
If the faults cannot be eliminated successfully by 6.1 to 6.6, inform the LH Servicing Department. Moreover, a Service Manual for fault finding and explanations concerning the test programs, in English language, is available.

Défaut dans le système de vide (voir notice d'emploi de la TURBOVAC, § Perturbations/ Remèdes). Appuyer sur »STOP« pour effacer le signal de perturbation.

6.6.3 à une fréquence de 2 Hz

Pompe surchauffée.
Le thermorupteur s'est ouvert – Panne d'eau ou d'air. Réparer et laisser refroidir suffisamment, puis appuyer sur »STOP« pour effacer le signal de perturbation.

6.6.4 à une fréquence de 4 Hz

Défaut dans le convertisseur.

N. B.
Si vous n'arrivez pas à faire la réparation en suivant les points 6.1 à 6.6, veuillez vous adresser à notre service après-vente. Nous fournissons en outre une brochure en anglais contenant toutes les instructions de dépannage et l'explication des programmes d'essai.

MP MASTER
MA32939

Allgemeine Hinweise

Eine Änderung der Konstruktion und der angegebenen Daten behalten wir uns vor. Die Abbildungen sind unverbindlich.

General Notes

We reserve the right to modify the design and data given in these Operating Instructions. The illustrations are not binding.

Remarques générales

Nous nous réservons le droit de modifier la construction et les données techniques. Les figures sont sans engagement.

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